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concrete construction

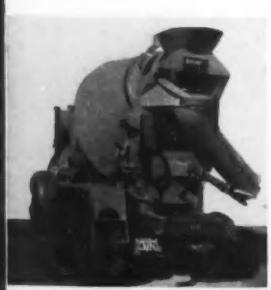
ARTICLES

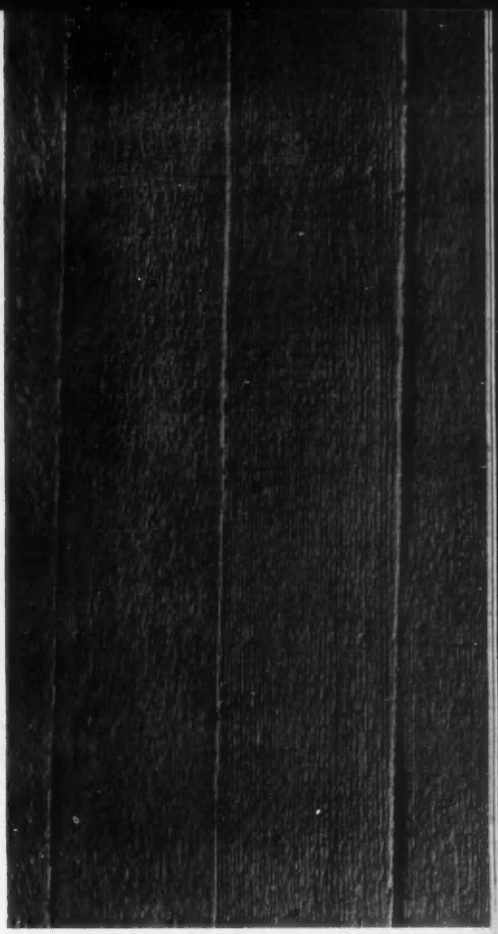
In the circus and carnival industry there is an unwritten law that every man must rally at once, and with all his strength, to assist a fellow worker who cries "Hey, Rube!" But how many people in the field of concrete are aware that we, too, have an unwritten but constantly functioning law which assures that no one need struggle for long in perplexity and isolation so long as he has the gumption to call for help?

Indeed, the fellowship that operates within the concrete industry runs circles around the "Hey, Rube!" fraternity because ours not only rallies assistance from nearby, but can and frequently does marshall skill and know-how from all over the globe. Throughout most of the civilized world today, sound experience and knowledge in the field of concrete can be tapped at almost a moment's notice, and it is safe to say that skilled help can sooner or later be brought to bear on even the most obscure and baffling problems.

No individual or organization in this complex field professes to know all the answers, but there are few problems in our industry that haven't been encountered before by someone, studied with great care, and dealt with in some fashion. And there are legions of people throughout the industry who are able and eager to help match up YOUR problem with someone else's experience.

So next time you're thoroughly baffled, try yelling "Hey, Rube!" How do you do it? Well, for a starter you might talk to your supplier of ready mixed concrete, or write to the editor of Concrete Construction Magazine. Neither may have the answer to your specific problem at his finger tips, but you'll be amazed at how much trouble they'll go to to see that you get help from some source.





Many interesting effects can be achieved quite economically by the utilization of the natural graining and jointing of ordinary form lumber to achieve special finishes. An example of this technique is pictured here.

Concrete builders and architects are making increasing use of a wide variety of forming and finishing techniques which take full advantage of the wonderful versatility of cast-in-place concrete. Here is a round-up of some of the more widely used methods.

THE CHANGING FACE OF CONCRETE

A NEW DIMENSION has been added to concrete. The material that has for years met the builder's needs with strength, weight and mass now offers a fourth advantage — beauty. No longer does the surface of a concrete structure have to assume a dull, flat, and monotonous finish. Through a variety of techniques and materials developed in both England and the United States in recent years, decorative effects are within the reach of any concrete builder willing to devote the time and develop the skills to produce them.

These decorative effects are basically achieved in either of two ways: they can be applied at the forming stage before the concrete has hardened, or they can be applied to the finished concrete surface. They range in variety from a deliberately roughened or overall textured appearance to a distinctly rendered design pattern or a smooth and glossy look one ordinarily associates more with marble than with concrete.

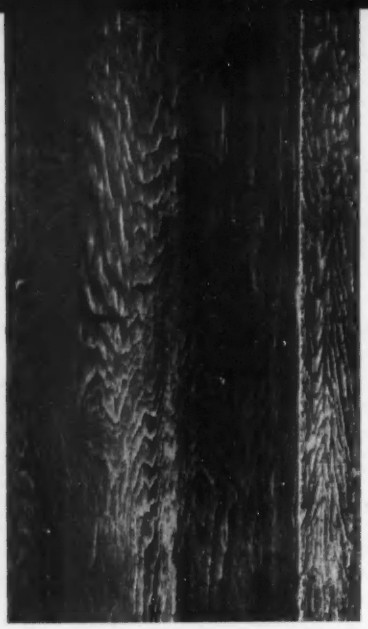
Some of the techniques required to obtain these effects are costly, whereas others are quite simple and inexpensive. There is in general, however, such a variety of techniques to choose from that you will ask yourself which one is most likely to enhance the finished appearance of the particular job under consideration.

For example, one customer might want a rustic look for a string of motel units. You can actually produce a woody appearance on the surface of concrete to satisfy this requirement! Another may want a structure whose walls will not invite the scribbled love messages of teenagers. A roughened surface will forestall this eventuality. Or you may be called upon to put up an office building whose walls will reflect a modern look through the use of a sculptured design. As you will see in this article, there are many ways of achieving such designs on concrete.

In covering the various effects that can be achieved on concrete surfaces, it will perhaps be most helpful to proceed as one would through the stages of any ordinary concrete construction job. Let's start with formwork.

form lumber
for board-marked textures

Probably one of the least expensive and least time-consuming methods for imparting a special finish to concrete is that of making use of the lumber used in formwork. Where no paint or stain is to be applied to the con-



This remarkable simulation of wood grain was obtained by casting concrete against plywood panels which had been wire brushed to accent the natural pattern of the wood grain. A brown acid stain was applied after the forms had been stripped.

crete, this is also probably the simplest method, requiring no care other than in the selection of the lumber.

Board-marked surfaces show the joint lines of rough or dressed lumber and often the grain impressions as well. The quality of surface produced depends upon the kind and grade of form lumber and the way it is used. Sound, straight lumber, free from large loose knots, should be required for practically all kinds of work. Douglas fir (sometimes called Oregon pine) and long leaf yellow pine are most commonly used. Both of these woods leave a more or less pronounced impression of the grain in the concrete, depending upon whether the boards are dressed or rough.

Where the scale of the structure permits a bold and rugged texture, slight cupping of the boards accentuates the joint lines. These joint lines may be made still more pronounced by using lumber dressed on one side, which is not sized as accurately as when dressed on both sides. To prevent excessive cupping, 6-d or 8-d common nails may be used, for they have greater holding power than the box nails used with narrower boards.

By choosing slash grain lumber a strong grain effect is obtained. The lumber should be surfaced on two edges to make the boards of uniform width and straight. This is necessary in order to draw the boards tight to prevent leakage. The wood-textured concrete illustrated was cleaned and stained with brown acid stain to help further create an illusion of wood. In this type of finish, the rustic appearance of wood is coupled with the fire-resistance and low-maintenance cost of concrete.

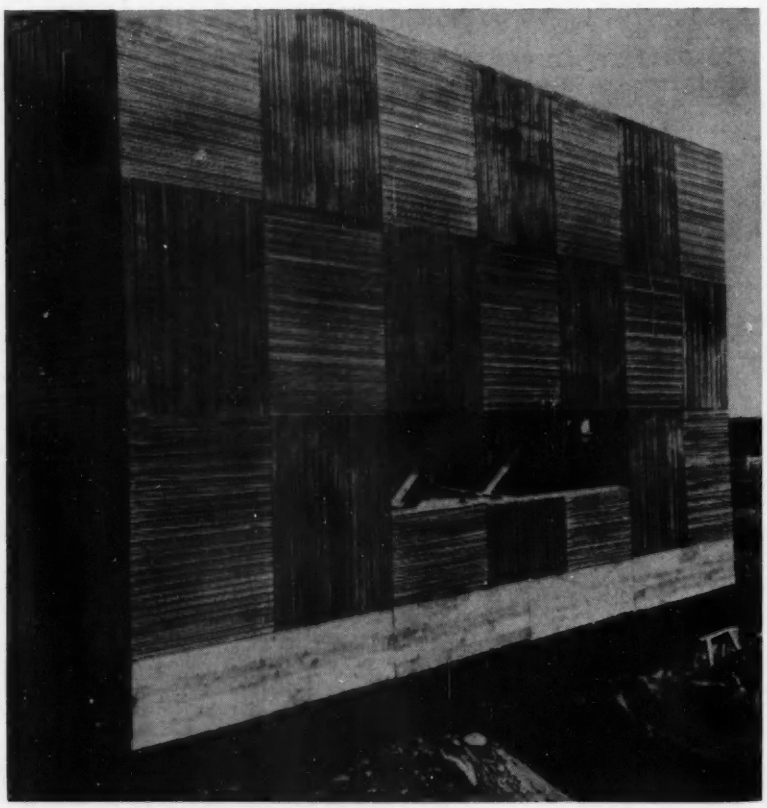
plywood forms for textured and smooth-faced surfaces

More and more manufacturers of plywood panels are today producing special grades and textures of this versatile material for use in concrete work. In addition to smooth-faced panels, specially manufactured to stand up under many cycles of use, there are now available a number of textured plywoods designed to create special effects in cast-in-place concrete work.

Some types feature a texture of deep, irregularly spaced, full-length grooves for producing one-way or vari-directional groove patterns. Low-cost panels are also available with contoured faces. These are produced at the mill by removing some of the soft grain growth to accentuate the natural swirls and contours of the face fir veneer. The resulting contoured concrete surface is especially effective for decorative building fronts, for low-cost interiors where minimum upkeep is an important consideration, and for such structures as bus, train and air-line terminals.

Where an especially smooth-textured finish is desirable, it is sometimes advisable to use plywood panels which have been smoothed with a plastic filler or lined with phenolic resin sheets. When applied to high-density exterior grade panels, the resin sheets are said to stand up under as many as 200 re-uses. The selection of types and grades of panels involves a number of considerations, but the expected frequency of re-use is one of the more important factors. For one-time applications, or where there is little prospect of frequent re-use, low-cost panels are entirely satisfactory, whereas costlier materials become quite

Striated plywood form panels, arranged in a checkerboard pattern, made it possible to produce this concrete surface at a reported saving of 10 cents per square foot below the cost of a conventional sack and rub treatment.



economical when there is the likelihood of many re-uses.

rubber form liners for patterned surfaces

Some striking—though more expensively achieved—patterns can be had by lining forms with a good grade of ordinary rubber sheeting. This technique was developed in England.

In precast concrete work, rubber sheeting of the desired pattern is placed at the bottom of the form or casting frame. Concrete is then placed over the sheeting, vibrated, and allowed to set. After it has set, the frame is removed and the unit turned upside down. The rubber sheeting, now on top, is then peeled away from the concrete, leaving a bold and striking impression.

Only thick and strong rubber sheeting should be used for lining, or it will tear as it is pulled from the concrete surface. Moreover a good quality of rubber can be re-used if properly stored in a clean, cool, and dark place.

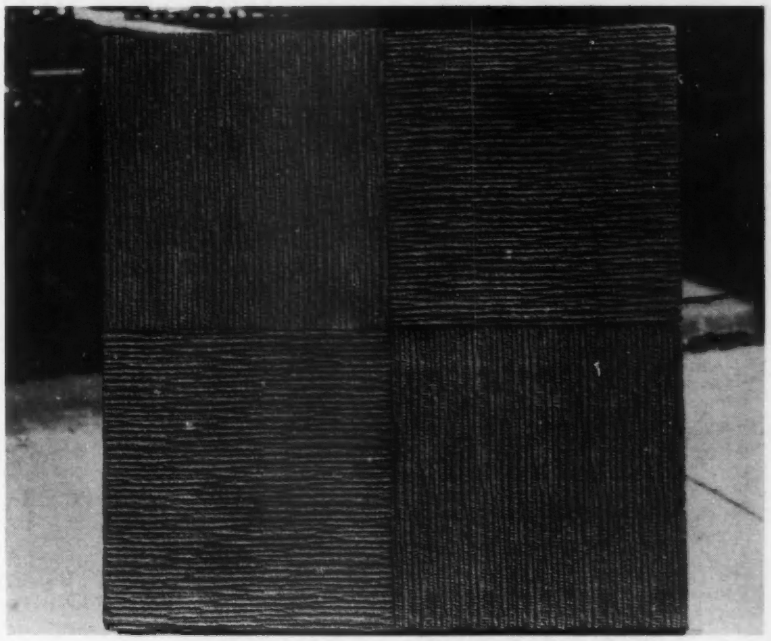
In poured-in-place concrete work, the rubber sheeting is either glued to the forms or fastened by means of clips. Where a form oil is to be used, there seems to be some preference for castor oil because of the adverse effects of mineral oils on rubber. Where no parting agent is used, be sure to allow ample setting time before stripping.

The use of rubber matting for lining formwork is a fairly simple operation, requiring little time and no special skills. The matting itself can be an expensive item if needed in large amounts. But even then, this cost may be offset by the fact that a finished textured surface is produced in one operation as opposed to other methods of finishing, such as tooling.

plastic form liners for patterned surfaces

One of the newest and most promising techniques for obtaining a wide variety of interesting surface effects in concrete involves the use of plastic form liners. Any standard concrete mix can be used with the liners, and it should be vibrated. The liner must remain in place at least 48 hours (and preferably three days) to achieve the high sheen and almost unbelievable smoothness it is capable of producing. Exposed surfaces should be covered during curing.

The important point to remember with the use of plastic form liners is that you must *not* use any form oil.



Especially suitable for ceilings, this textured surface was produced by lining conventional formwork with a rubber form liner.

After stripping, rinse down the surface with water and rub with a clean cloth. The lightweight plastic material comes in a variety of patterns and may be re-used many times if properly cleaned and stored.

If the resulting smooth—indeed, almost glass-like—concrete surface is to be used under conditions of considerable weathering, it is advisable to coat the surface with a silicone solution.

As with the use of rubber form liners, this technique is relatively simple, inexpensive since the linings are re-usable, and both time- and money-saving since the finishing operation is combined with that of forming.

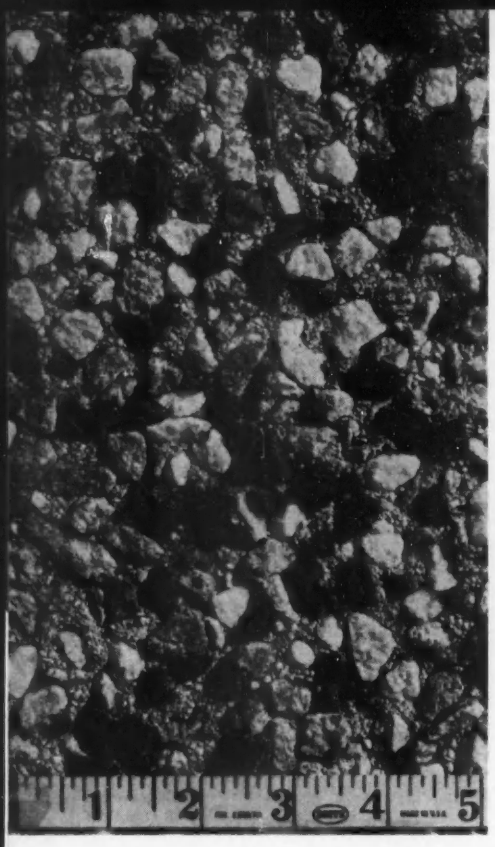
exposed aggregate surfaces

A number of comparatively simple and quite successful techniques have been developed for producing exposed aggregate surfaces having both the color and the texture of natural aggregate. Perhaps the simplest means of producing surfaces of this type is to use a chemical coating either on the formwork, when vertical surfaces are involved, or on the freshly placed plastic concrete, when it is desired to expose aggregate which is to chemically retard the set of the mortar at the surface of the concrete, so that as soon as the mass of concrete has hardened, the retarded mortar can be washed away with a jet of water or removed with a stiff brush.

Chemical coatings of this type can be applied either by brushing or by spraying. They usually contain dye coloring to help in determining that a uniform coating has been applied. The depth to which the aggregate will be exposed bears a direct relationship to the amount of chemical applied, as well as to the time lapse between placing the concrete and removing the surface mortar.

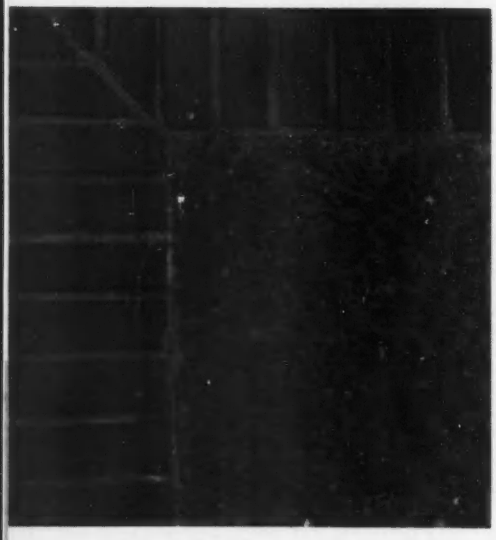
For most purposes a ⅛-inch penetration is desirable. In the case of concrete coatings, this may be obtained by removing surface mortar 12 to 24 hours after the concrete is placed. When the retardant material is applied to the formwork, good results are usually obtained by stripping the forms and removing the mortar in 1 to 3 days in summer and in 2 to 5 days in cool weather. Multiple coats of the retardant chemical are recommended when early stripping is not possible.

Satisfactory chemicals of this type must truly retard rather than kill the set of the mortar. The retarded mortar should harden within 28 days and gain satisfactory strength in 90 days. After all retarded mortar has been removed by brushing or by means of a



An example of the textured surface which can be produced by means of the aggregate transfer method. By using materials of various sizes and colors, there is literally no limit to the variations possible in the finished surface.

This exposed aggregate pavement, edged with brick units, was produced by scattering pea gravel over freshly screeded concrete, and then spraying the surface and gently brooming after the concrete had set.



water jet, it is important that the concrete be thoroughly cured in the usual manner. Most chemicals of this type work satisfactorily on either new or used forms made of such conventional materials as plywood, steel, ordinary lumber or masonite.

Another technique for producing exposed aggregate surfaces is the aggregate transfer method which is uniquely adapted to surfaces which come in contact with formwork. It consists of gluing a layer of decorative aggregates on a sheet of plywood. The plywood is then attached to the interior of the forms. After the concrete is placed and cured, and the forms stripped, it is found that the aggregate layer has been transferred to the concrete, the bond of the aggregate to the concrete being greater than to the form.

In applying this technique, special attention must be paid to the shape, size, and color of the aggregate used. Spherical or cubical aggregate transfers better than the flat type. Marble chips have so far been judged to be the most practical choice. Ceramic chips, while colorful and attractive, are more expensive.

Proper preparation of the liner is most important. The entire surface should be thoroughly covered with aggregate and then vibrated horizontally to assure an even layer of material. The concrete must likewise be thoroughly vibrated to achieve adequate bond to the aggregate. The liner is allowed to stand overnight so that the adhesive hardens before it is attached to the forms.

Liners should be left in place as long as possible—even after forms have been removed—for they aid in proper curing. When they are carefully peeled back from the concrete, a colorful, maintenance-free surface is exposed.

The cost of employing this technique to achieve a decorative surface will largely depend upon the price of the aggregate selected and the time and skill that must be invested to get worth-while results.

Exposed aggregate surfaces offer the great advantage of presenting the toughest part of the concrete mix, the stone aggregate, for a wearing surface. They also offer an infinite variety of effects, depending upon the color of the aggregate used, their size and shape, whether they are left rough and pebbly or ground down to a smooth finish, and whether or not the concrete itself is colored for contrast.

Because they are tough-wearing and attractive, exposed aggregate surfaces can be used for pavement work—particularly where a special effect is desirable, such as the walk to a house or swimming pool.

Briefly, this is accomplished by scattering clean pea gravel over the surface of freshly screeded concrete. The gravel should be placed one pebble deep with space between pebbles no greater than their own diameter. If surface water has disappeared, float the area, imbedding the pebbles in the fresh concrete so that they disappear completely. After the concrete sets, spray the surface with water and then broom gently, leaving about one-third of the pebbles projecting from the solid concrete. Skill and care are especially required during this last stage so that you do not wash or broom away too much of the concrete. The amount flushed away should be just enough to expose the pebbled texture.

rough or dimpled surfaces

This type of surface, though smooth to the touch, has an uneven textured appearance that is hard-wearing and inexpensive to produce.

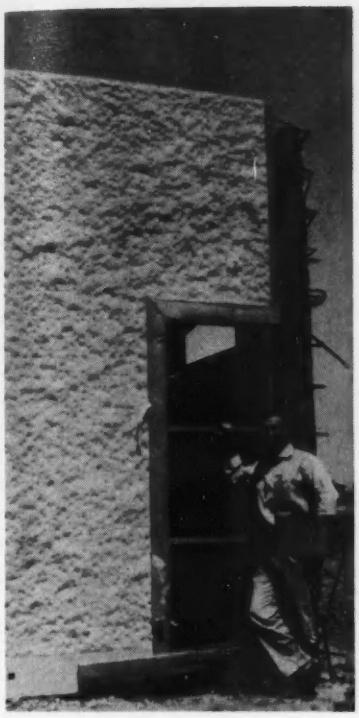
In concrete wall-panel work, simply spread a layer of crushed rock in the casting form. Then lay plastic sheeting over the rocks before pouring the concrete. After the wall panel has been stripped from the form and tilted into place, its underside reveals a softly dimpled surface.

This technique for producing an unusual surface pattern should appeal because it requires no special skill beyond that of following standard procedures for tilt-up construction. The materials used—crushed aggregate and plastic film—are easily obtainable. The technique has many applications for walls, precast sidewalk panels, and patio sections.

stamping tools for patterned surfaces

So far we have been concerned with techniques for producing unusual surface effects through some special treatment of formwork. But concrete lends itself to decorative approaches in its partially set and even completely hardened stages.

One interesting technique is that of using stamping tools on the freshly finished surface. These tools are made of lightweight aluminum and come in



This rough-textured wall was produced by the tilt-up method, the outer face being cast down against a sheet of polyethylene film placed over graded gravel and crushed rock.

a variety of brick and tile designs for sidewalk, garden, and patio work.

The tools are actually platform walking units. By placing one tool in front or by the side of another, the user may walk over the surface of the concrete as he simultaneously stamps a continuous pattern into it. In this type of surface work, the concrete should contain aggregate not larger than one-quarter inch, and the cement content should be increased to provide the same richness as a standard mix.

After the slab has been stamped and cured for a period of not less than three days, the joints produced by the tools may be partially filled with mortar.

Since the tools are re-usable, this technique is quite economical. It does not require a great amount of time and skill on the user's part—just accurate lining up of the pattern.

grinding tools for smooth surfaces

Sometimes a customer's or an architect's specifications will call for a finely finished concrete surface. At one time, this meant long hours of hand rubbing, but now through the use of power tools, operating at high speeds, a smooth surface is easily created.

There are two methods employed to smooth down hardened concrete. One is wet rubbing and the other dry grinding.

Wet rubbing is done shortly after the forms are removed to fill in voids and remove form marks. The application of water plus a grinding wheel or disc brings a wet cement paste up to the surface of the concrete. The paste is then rubbed into air pockets and other voids. This leaves a smooth finish.

Dry grinding is done on dry concrete surfaces to remove fins and marks caused by forms. Newly developed abrasive discs are excellent for this kind of work. They can be applied to the surface at an angle of 30 to 40 degrees, using the weight of the tool for pressure.

Through the use of these new power tools, with various adjustments and adaptations built into them, a smooth finish can now be worked into concrete floors, walls, and ceilings without going to the great effort and expense of hand labor.

tools and materials for applied finishes

Last, we come to the immense variety of textures that can be externally applied to the finished concrete surface. They may be applied either by hand or by mechanical means, and often serve a functional as well as decorative purpose — *i.e.,* protecting the wall against rain penetration and streaking. The important point to keep in mind about applied finishes is that they must be chosen to suit the background material and the conditions to which this material will be exposed.

One type of applied or rendered finish is called the "pebble dash"—in which small stones are thrown into a final coat of freshly applied mortar (properly proportioned cement, sand, and aggregate). The pebbles are lightly pressed into the mortar after throwing and should give an attractive, long-wearing surface.

A variation of the above is the "roughcast" or "wet-dash" finish, in which a final coat, containing fairly coarse aggregate, is thrown on as a wet mix and left in the rough condition. A final coat of stiffened mortar containing no aggregates can be scraped with a steel straight-edge or a board studded with nails to give a

A pleasing, old-world atmosphere was accomplished by jointing the surface of this sidewalk with a stamping tool. The basket-weave pattern shown is only one of many available.

The surface of this concrete arch shows a comparison between the effects of hand tooling alone (coarse textured areas) and a combination of hand and mechanical tooling.

is a matter of the technique used and the surface involved. Usually, a mushy consistency is achieved with a whisk-broom or fiber brush, using a whipping motion.

It is sometimes necessary to spray or finish an externally applied surface with water or to protect it from the sun and wind in order to prevent it from drying out too rapidly. If possible, avoid carrying out finishing treatments in severely cold weather.

Through the use of new tools and techniques, continually being perfected, the variety of finishes attainable to give a new and changing face to concrete is almost unlimited. Actually, the possibilities are as boundless as the skill and imagination of the concrete builder. END

third variation of a rough-textured outer surface.

Actually, a variety of different tools may be used on the freshly applied outer coat to give a ribbed effect, a fan texture, or an English cottage texture. Machine-applied finishes, in which the final coat is spattered or thrown on the wall, create some further interesting textured looks.

Bush hammering with hand hammers or tooling with pneumatic tools and sand blasting are also used with good success in applying a new finish to well-seasoned concrete. With methods involving tooling, some of the aggregate particles are broken, thereby exposing their color and structure.

Applied textures involving stucco are numerous, and the finish obtained

Descriptions of techniques in this article are necessarily brief. For readers who would like more detailed information on any of the methods covered, tearsheets or photo copies of the following articles can be supplied at 50 cents per article. *Please enclose remittance with your order.*

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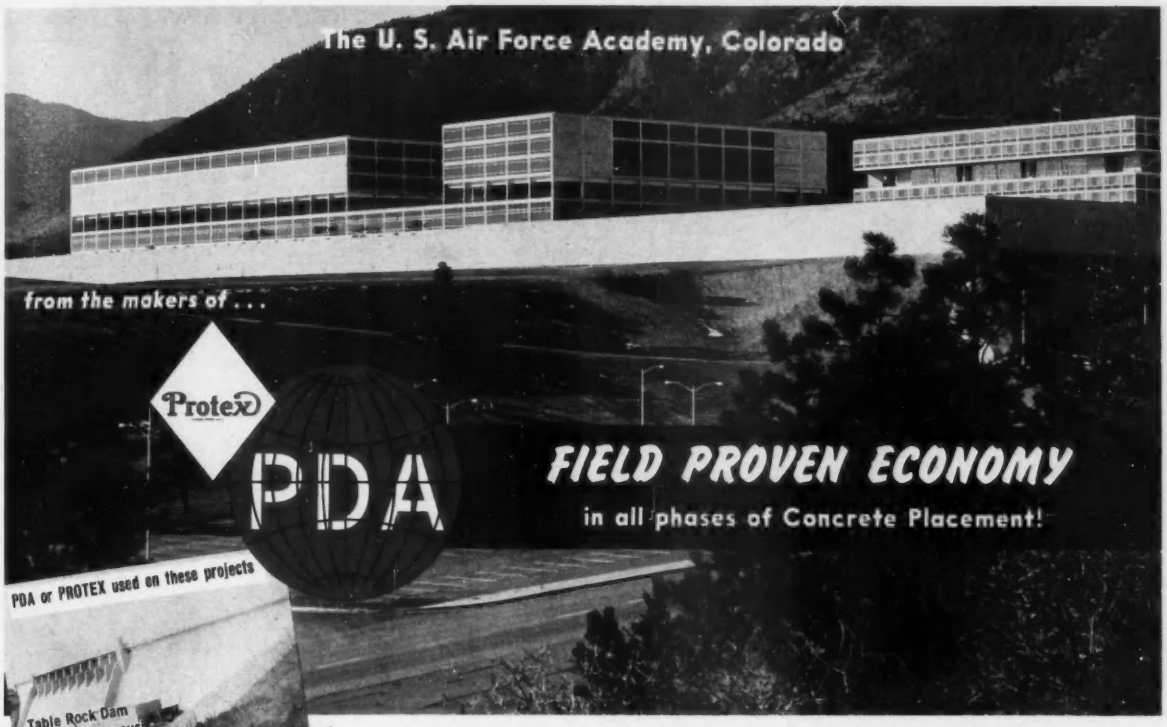

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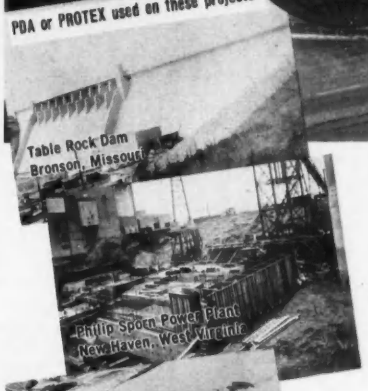

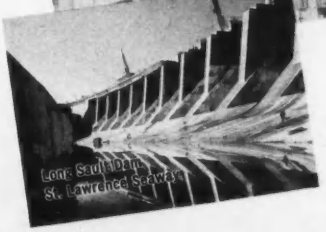

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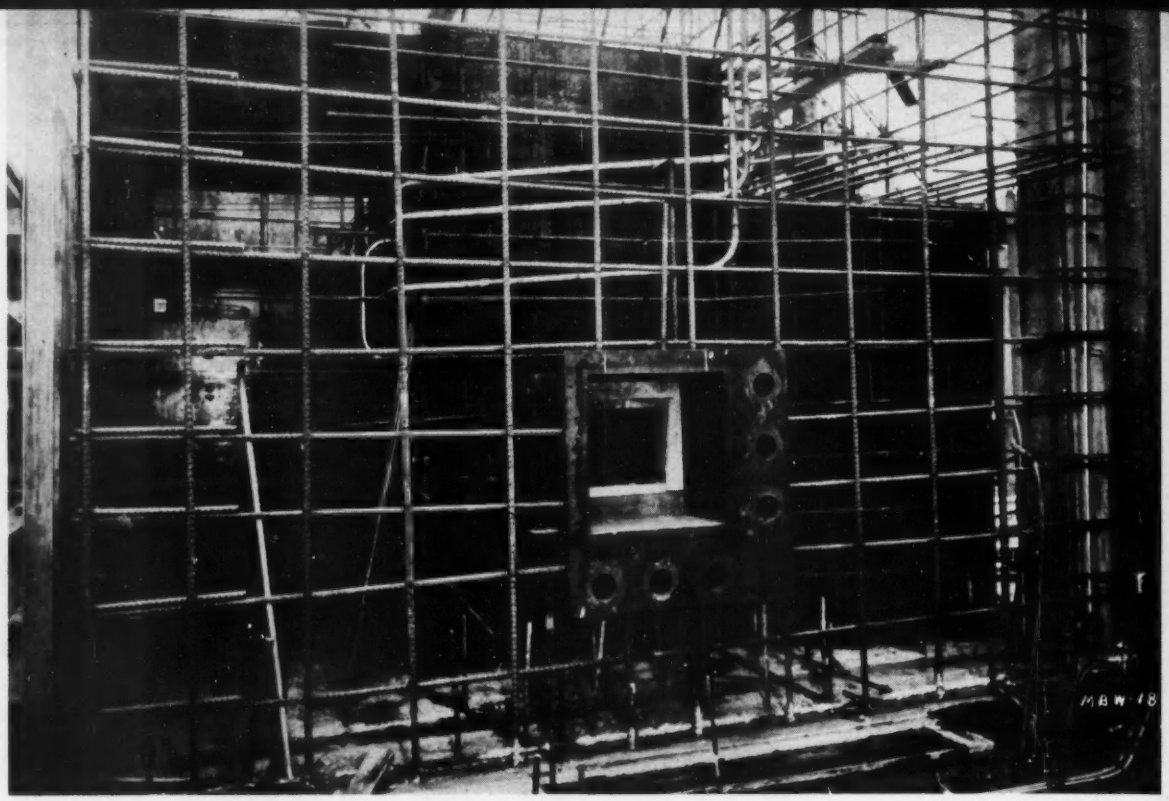


Photos courtesy The Master Builders Co.

Maze of steel reinforcing bars surround steel shell for hot cell before 66-inch thick concrete walls were placed. Aperture is an access port into the cell.

NORMAL CONCRETE FOR RADIATION SHIELDING

Here is the first account of what is believed to be the first utilization of normal concrete as protection against radiation hazards.

FILE: Shielding

MOST DESIGNERS AND BUILDERS today are familiar with the advantages of using very high density concretes for radiation shielding. Not so well known is the excellent economy which can result from the use of normal site-cast concretes with locally available aggregates when space and other factors do not absolutely demand that the desired protection be achieved within minimum dimensional limits.

The effectiveness of any biological shielding material is related only to its mass, and concrete has an obvious advantage in this highly specialized field of construction because of its exceptionally low cost per pound. Lead, for example, because of its high density, is an ideal shielding material where thinness alone is a dominant consideration, but it is a relatively costly material and its structural properties are very poor.

On one recent project, a radio isotope handling facility for Picker X-Ray Company at Cleveland, designers made a careful survey to resolve the problem of material selection on the "most per dollar" rather than on the "least expensive" basis, and site-cast normal concrete came through with flying colors. It was found that lead would cost approximately 50 times as much as concrete, and this solution was quickly tabled on the basis that in a new structure there was little need for

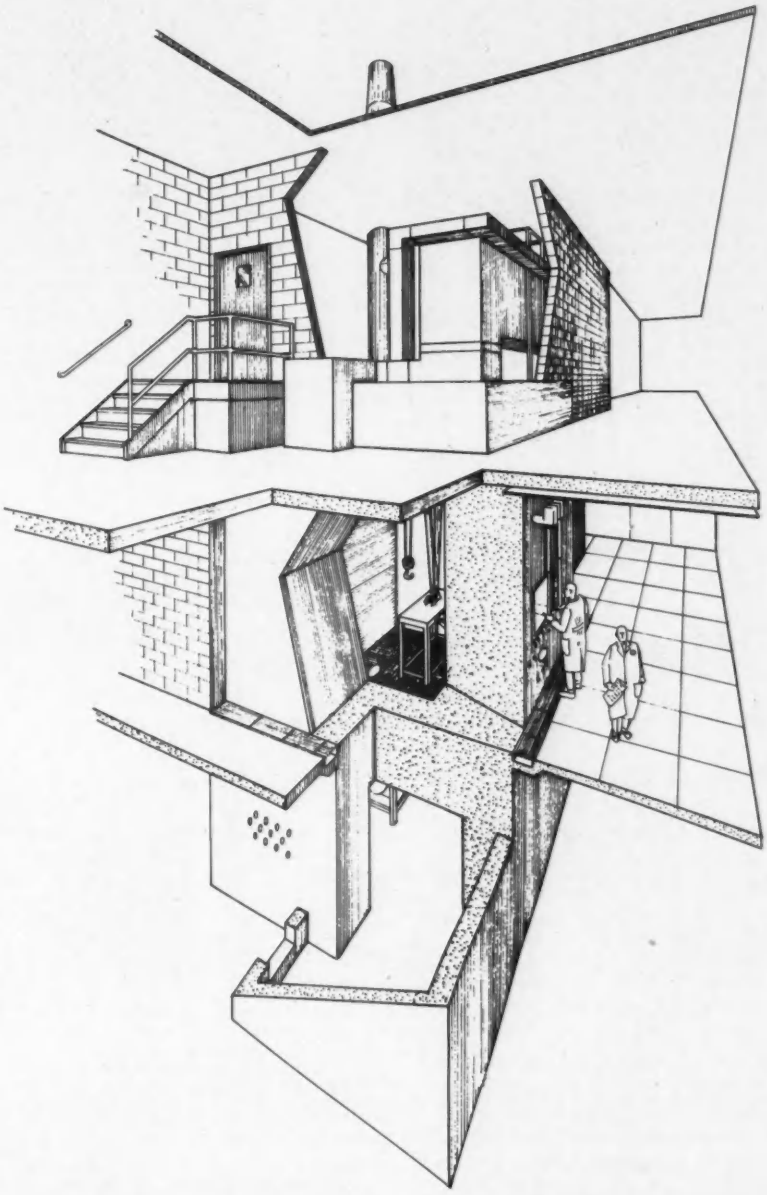
space conservation. With the field of investigation narrowed down to concrete, the next consideration was whether or not to use a high density mix incorporating steel punchings and chilled iron shot aggregate. Normal concrete won out in this comparison, again largely on the basis of cost, it being found that the high density mixes might cost as much as $357 per cubic yard for materials alone against around $15 per cubic yard for normal concrete with local aggregates. Finally, it was decided to use site-cast concrete rather than block because of its somewhat higher density (at least 10 percent), and superior economy (solid block construction is about 1.2 times as expensive as cast-in-place concrete).

Specifications for the Cleveland project called for 3000 psi concrete having a minimum weight of 150 pounds per cubic foot. A water-reducing admixture was used in order to achieve maximum density of the finished concrete and to minimize danger of cracking. The mix design called for 517 pounds of Type I portland cement, 1475 pounds of Pelee Island sand, 1900 pounds of coarse No. 4 dolomite crushed stone, and 38.5 gallons of water per cubic yard of concrete. The water reduction obtained with the admixture permitted the use of an additional 140 pounds of coarse aggregate, and the final mix weighed 155.4 pounds per cubic foot.

This mix was used initially for ordinary structural purposes in the building in order to observe its performance before employing it as a shielding material. Based on the experience thus gained, the final shielding mix included 16 cc. of an air detraining agent. The resulting concrete had a slump of 4½ inches and met the density requirements with less than 1 percent air.

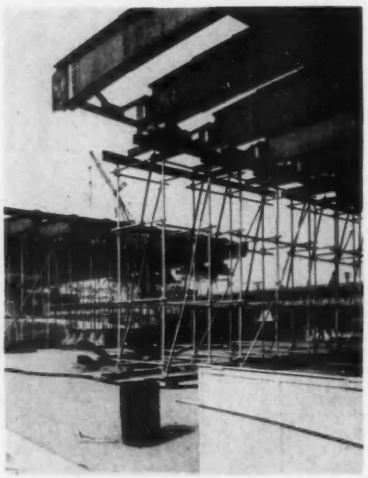
A total of 271 cubic yards of ready mixed concrete was used in the 5½-foot thick concrete walls and the 4-foot thick concrete floor and ceiling which surround the hot cell. The resulting 1,140,000 pounds of concrete shielding cost $12,100 in place, or approximately 4 percent of the cost of other high density materials which were studied in connection with the project. Apart from the cost factor, the successful adaptation of normal concrete to shielding installations will have far-reaching effects upon the quality of the concrete which can be supplied for such projects. For the know-how and skill required to produce and place normal concrete are widely available, whereas the production of successful heavyweight concretes still involves a great many uncertainties and headaches with which only a small handful of people in the industry have come to grips. END

Readers who would like to have additional information on the subject discussed in the foregoing article may request it by mailing in one of the reader service forms in the back in this issue.

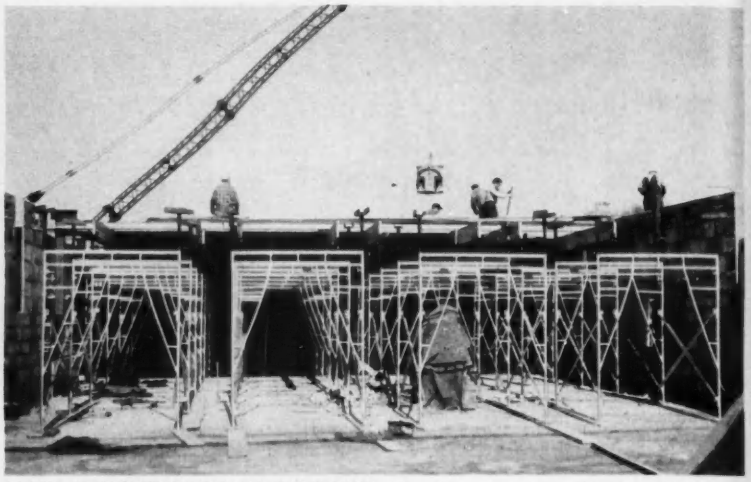


Cutaway drawing of hot cell shows all three levels that were surrounded by 66-inch thick concrete walls. Isotope handling room is located on second floor cell, has 4-foot thick floor and ceiling. The concrete was placed in three separate pours of one story each, the separate sections being joined by 3- by 10-inch keys at each floor line.

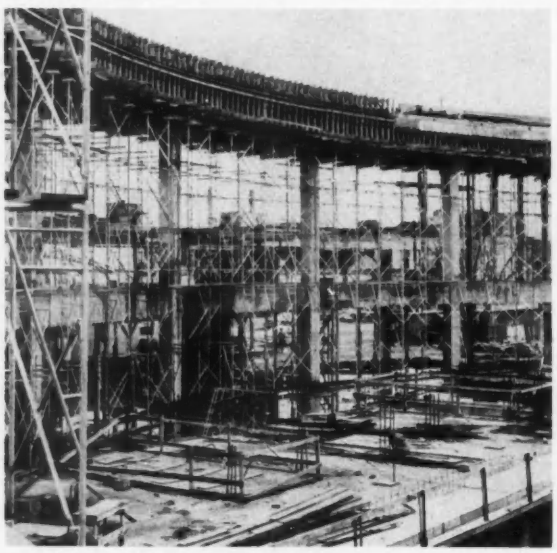
Shoring Methods . . . by Patent Scaffolding Co.



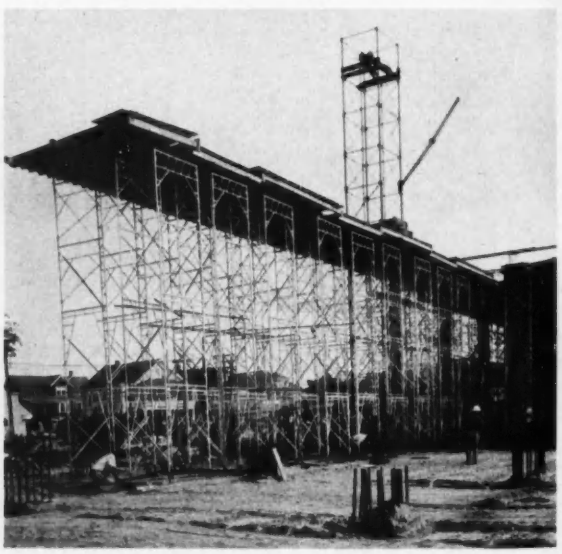
CUTS COSTS 20%—"TubeLox"® Steel Shoring "towers" permit setting several dozen steel girders a day on overpass in downtown St. Louis. Instead of setting and riveting one girder at a time, thereby making iron workers dependent upon movement of cranes, St. Louis Steel Erection Co. keeps workers on the job, eliminates lost motion, and cuts working days by 20%.



NEAT, QUICK ROOF SLAB SHORING—Simple, easy-to-erect frames of "Trouble Saver"® Sectional Steel Shoring are rapidly set in place to support the formwork for the slab roof of the new Southwood Acres School, Thompsonville, Conn. Only 700 6'6"-high frames are required. Spaced 7' apart with 3' to 4' spacing between rows, these "Trouble Saver" Shoring frames adequately support all the load encountered. Notice how the free standing sections are neatly arranged ready for the placement of forming lumber. U-heads placed in the tops of the scaffolding frames are designed to hold the wood stringers. 20" adjustable leg attachments provide the precision shoring height required. Detailed layouts, supplied by PS Co., make assembly on the job site quick and easy. John Romano Contractors, general contractor.



SUPPORTS 3165 LBS. PER FOOT—Here, "Trouble Saver" Sectional Steel Shoring components are shown arranged to support a 242' diameter concrete beam, 47' above ground. Beam is 5'8" wide, with irregular depth to 4'6". While the height to which this shoring is erected is interesting, the major importance is the fact that it is assembled to carry a load of 3165 lbs. per lineal foot of beam. Utica (NY) Memorial Auditorium. Sovereign Construction Co., Ltd., general contractor.



SLIDING SYSTEM FOR MINIMUM EQUIPMENT—To gain the substantial cost advantages of minimum equipment, Frank Briscoe Co., Inc., here uses sectionalized set-ups of "Trouble Saver" Shoring which can be slid from pour to pour for the 8" floor slab of the new 250' by 275' Western Electric Co. Bldg. Boston. 22' x 125' shoring sections, with forms and dropheads in place, are slid forward between columns by cables attached to wood sills. Bulldozer used for power. Photo shows one narrower section just after movement.

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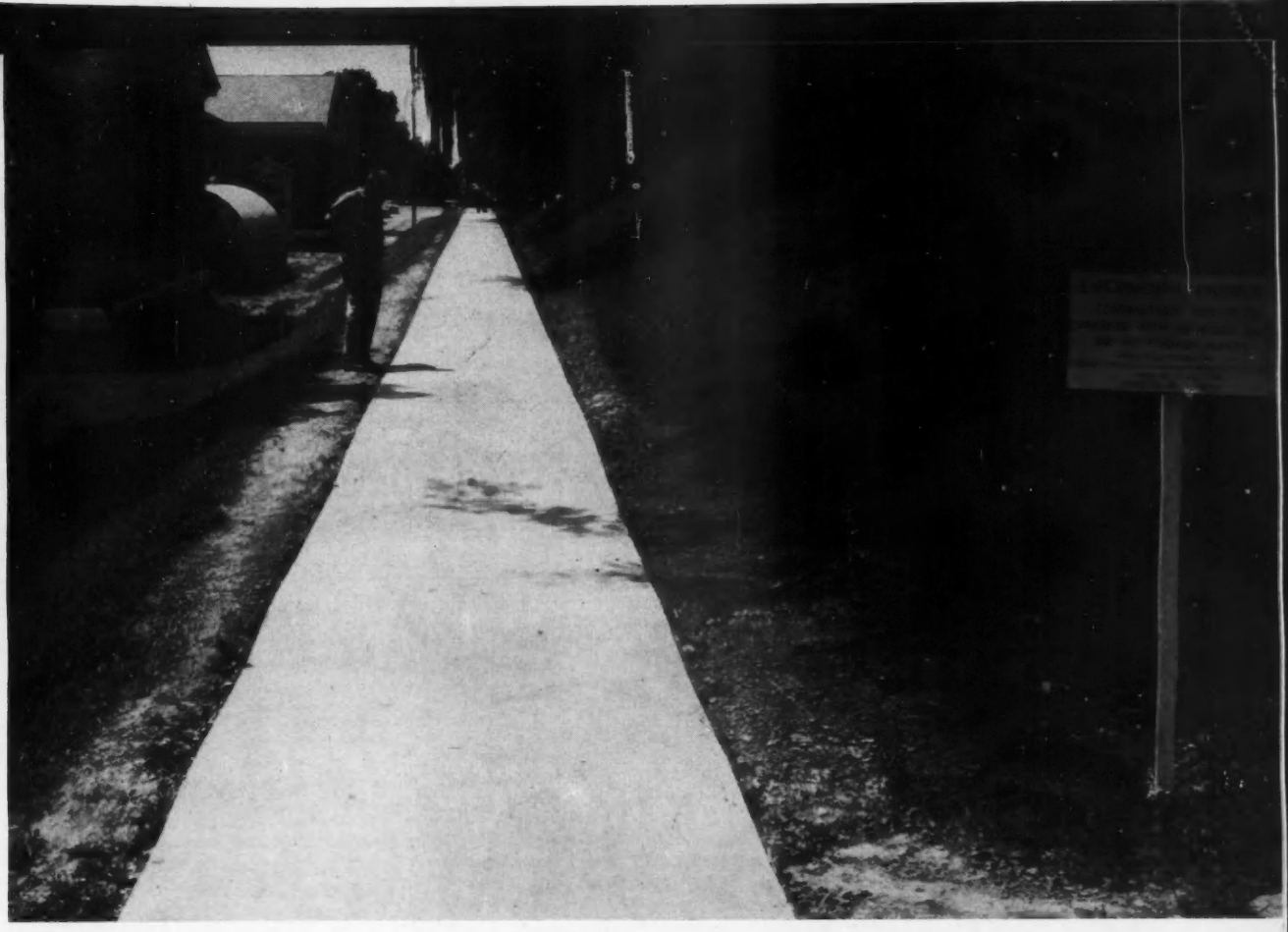


Monolithic Anchors Control End Movement of Continuous Pavement

BY STAFFORD E. THORNTON*

A 300-FOOT SECTION of continuously reinforced concrete sidewalk on the campus of the University of Virginia has provided some useful information which will shortly be applied to full-scale highway pavement construction. The main purpose of the model study was to test the effectiveness of a system of anchors, consisting of keyways or lugs cast monolithically with the pavement, to prevent the sizable end movements which have been one of the chief problems with continuous slabs of this type.

Continuously reinforced concrete pavement is a new type of concrete highway construction which grew out of the need to solve the problems involved with joints. Continuous pavement differs from the conventional type of concrete pavement in that it has no formed joints to allow for expansion or contraction. The theory is that as the concrete cools and tends to contract the pavement will crack, but sufficient reinforcement is used to hold these cracks tightly closed. The advantage of this type of pavement is that the cracks are so small that no sealing material is necessary to keep out water and that the motorist, of course, isn't annoyed by the constant "thump-thump" of the conventional pavements.

Continuously reinforced pavements have been built in six states to date, and all of these pavements have given highly satisfactory results. However, one of the chief difficulties has been the joining of the new type pavement with existing structures, such as bridges, intersections, and old sections of roadway. It can be seen that a continuous slab will have considerable end movement due to the expansion and contraction of the slab. However, it has been shown that due to the weight of the slab, and because of its frictional resistance in moving over the subgrade, actually only the end 150 to 200 feet of the slab moves. This still

*The author was a special undergraduate trainee in charge of experimental work at the University of Virginia to determine the effectiveness of the anchoring system described in this article.

FILE: Paving

Trench for one of the anchors, with reinforcing in place, ready to be cast monolithically with the pavement.

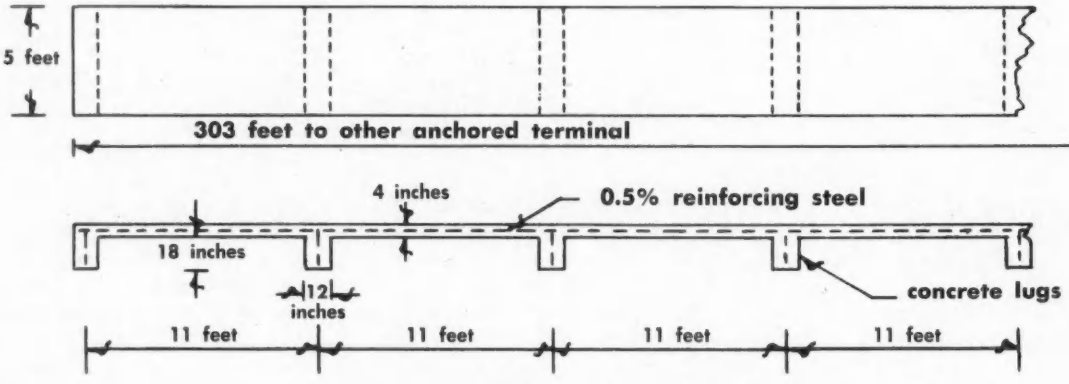
causes movements of as much as four inches. Self evidently, a joint which will allow that much horizontal movement with no vertical movement must be a large and expensive structure.

To solve this problem Dr. William Zuk, Associate Professor of Civil Engineering at the University of Virginia, devised a system of anchors which would hold the end of the pavement and allow no end movement. This was to be accomplished by a system of keyways or lugs which are cast monolithically with the pavement.

The Virginia Council of Investigation and Research decided to use Dr. Zuk's anchored ends in an experimental section of highway to be built near Emporia, Virginia. However, before using the new design a model study was proposed. The author was hired by the Council as a special undergraduate trainee to take charge of the construction of the model and do the preliminary investigations involved. A site was then chosen on the grounds of the University of Virginia and the model built in July 1958.

A length of 303 feet was deemed adequate since, as stated before, only the end 150 to 200 feet move. The width of 5 feet was selected since the model was to be used as a sidewalk and a 4-inch thickness was used instead of the usual 8 used on highways to save in cost.

Using thermocouples set in the pavement, and a device for measuring the crack widths to the nearest ten thousandths of an inch, it was found that



Anchored Terminal of Experimental Continuously Reinforced Concrete Pavement

View of a typical crack in the finished pavement.

the crack widths vary directly with the temperature of the pavement as can be seen in the graph. It was also established that in the section reinforced with smaller bars, the cracks occurred closer together than in the other section, the average distances between cracks being 6 feet in the section reinforced with small bars and 10 feet in the section reinforced with larger bars. Besides being closer together, it was observed that the cracks were held more tightly closed in the section with the smaller bars.

However, the most important finding of this project is that there has been no measurable end movement. Based on this, Dr. Zuk's anchors may be expected to be successful in the full scale pavement to be built by the Virginia Department of Highways in the very near future. END

SKYLIGHTING IS PROVIDED by placing every other roof slab on a higher column, then filling the vertical spaces between the slightly overlapping slabs with translucent plastic. Motel has 20 units, each 14′ x 28′.

Hyperbolic paraboloid shells form motel roof

EIGHTY CONCRETE SHELLS, site-cast in forms shaped like inside-out umbrellas, provide an arresting yet functional roof for this motel on the Tamiami Trail in Florida. The hyperbolic paraboloid squares, 14′5″ on a side and 2″ thick, are placed atop prestressed concrete columns which alternate in height, permitting the squares to overlap. The resulting vertical spaces between the staggered slabs are filled with translucent plastic to form skylights.

The steel-reinforced columns are welded to steel plates set in 10″ x 2½′ square concrete footers below the concrete floor slab. This provides adequate foundation support in the sand and marl soil. Each paraboloid roof shell, dropping 2′ from perimeter to center, drains rain to a pipe in the supporting column, which connects with a central drainage system.

Each shell required 1½ cu. yds. of ready-mixed concrete. Since the shells were removed from molds within 3 days after casting, to permit re-use of the forms, an unusually rich mix was employed to assure high early strength. A 3-week curing period followed.

Uniform high quality of concrete and convenient placement in the forms were assured by using truck mixers of certified design, capacity, mixing speed and water control accuracy.

ASSEMBLY LINE PRECASTING in re-usable molds reduced erection time. Each shell weighed 5 tons. Old tires protected edges while moving. Victor A. Lundy, Sarasota, Fla., architect; Spear, Inc., Venice, Fla., contractor.

FASTENING THE COLLAR: Steel collar, centered in roof slab, is welded to steel in supporting column. Rain water drains down through pipe in column.

Here low-slump concrete has been strategically placed on a pavement subgrade just ahead of one type of spreader.

BY GEORGE R. BATHE*

READY MIXED CONCRETE FOR USE IN HIGHWAY PAVEMENTS

Earlier this year we ran three articles discussing truck mixed concrete for pavements from a somewhat theoretical point of view. Here, now, is another viewpoint based on actual experience.

UNTIL COMPARATIVELY RECENT TIMES the contractor believed it was more economical to mix his own concrete, and the ready mixed concrete industry faced a real challenge in introducing its product. This challenge has been successfully met, and in most cities today the building mixers have been disposed of and the contractors are using the services of the ready mix industry. With the normal amount of highway construction located within economical haul distance of ready mix plants, plus the tremendous amounts of interstate highway and modern traffic-way construction, there has developed a large potential market and a tremendous new challenge for the ready mix industry.

For many years the writer's company has supplied most of the regular city paving in Omaha, and perhaps because of this paving experience, we were eager to supply ready mixed concrete on highway pavements, extending from the edge of the metropolitan area that we serve, into the heart of the city.

*The author is president of Ready Mixed Concrete Company, Omaha, Nebraska, and this discussion is based on a paper he presented at the 29th annual convention of the National Ready Mixed Concrete Association in New Orleans, February, 1959.

FILE: Paving

Omaha, Nebraska and Council Bluffs, Iowa are located on opposite sides of the Missouri River, which is the boundary line between the two states. The metropolitan area we serve has a population in excess of 400,000. Six of our ready mix plants are located in Omaha and its environs, and we are now completing construction on our seventh plant, which is located in Council Bluffs. We operate a truck mixer fleet of 93 units.

In 1957 we contracted with the Peter Kiewit Sons' Company of Omaha to deliver a highway pavement project on U. S. Highway No. 75, extending from near the headquarters of the Strategic Air Command south across the Platte River near Plattsmouth, Nebraska. This project was 4.5 miles of 24-foot wide, 9-inch thick pavement. One of our ready mix plants located at LaPlatte, Nebraska was about midway on the project. This plant is a dry batch type which charges the truck mixer with a ribbon feed. Our contract called for a minimum of 70 cubic yards per hour, and our average delivery was 125 cubic yards per hour, or 1,000 cubic yards per 8-hour day.

In 1958 we contracted for and delivered concrete on a project southwest of Omaha, consisting of 14.6 miles of pavement 24 feet wide and 9 inches thick. Eighty percent of the project was built by the Roberts Construction Company of Lincoln, Nebraska, and 20 percent by the Peter Kiewit Sons' Company. This concrete was delivered from our plant located at Millard, Nebraska, which is approximately midway on the project. This plant is of the central mixer type. Our longest haul was 8 miles. Our contract called for a minimum delivery of 125 cubic yards per hour, and on steady runs we delivered 135 to 140 cubic yards per hour. On several occasions we reached 180 cubic yards per hour.

The interstate highway in Nebraska enters Omaha from the southwest. We are under contract with the Peter Kiewit Sons' Company to supply a section of the interstate, including two interchanges, which will require approximately 60,000 cubic yards to begin in early spring. Our contract with the Kiewit Company calls for a minimum delivery of 125 cubic yards per hour.

As ready mix producers learned that we were supplying concrete for highway pavements, we were asked many questions. Probably the three most commonly asked were:

(1) How are you able to meet the rigid specifications?

(2) How are you able to sell the contractor?

(3) Did you find this type of work profitable?

In answer to the first question, we have maintained close contact with the State Highway Department engineers for two purposes:

(1) To assist in developing ready mixed concrete specifications which are realistic and would result in our producing and delivering a product equal to or superior to that which a contractor could supply for himself.

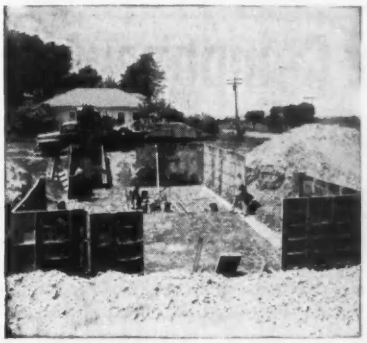
(2) To make it clear that our company was willing to make a capital investment in equipment and to train our personnel so that the State would be assured of a high standard of performance.

(continued on page 18)

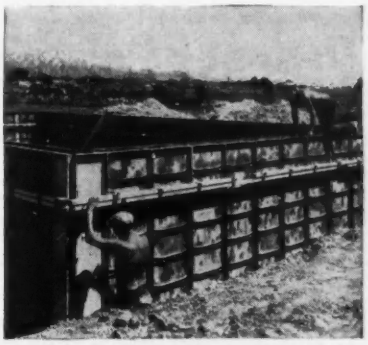
9 to 11 House Foundations Every Week with 5000 sq. ft. of SYMONS Steel-Ply Forms

Pouring 9 to 11 house foundations a week is a regular occurrence in the sparsely populated area of Logan, Utah. In fact, Morris J. Smith, the concrete contractor, and his crew with about 5,000 square feet of Symons Steel-Ply Forms have poured more than 400 foundations in 2 years. The plywood has not been turned and is still good for many more pours. Here is a typical example of how Smith achieves speed and economy in his concrete work:

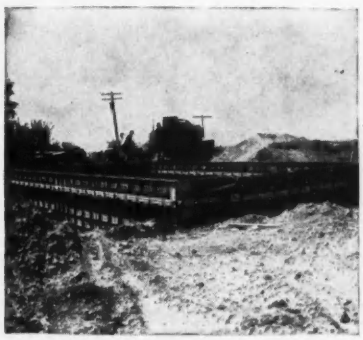
It's 9:00 A.M. . . . Flatbed trucks back on to job. Compartments built on the trucks, separate fillers and panels. Fillers are loaded on the front end and the full size panels are loaded on the back. The truck is used as a warehouse, with each filler and panel having its own specific place. This helps to speed loading and unloading.



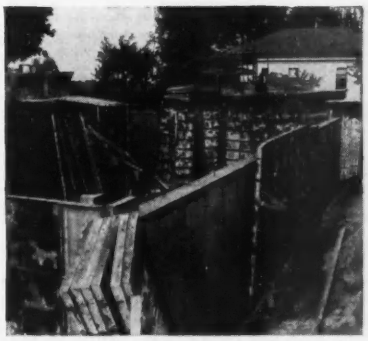
Setting up Four Corners Starts Erection. Each outside corner is erected by one man. The men do not work in pairs . . . each works singly. The outside walls are erected first. By starting at the corners, the men meet in the middle, insert the size filler it takes to finish the foundation . . . forming is completed and ready for pouring.



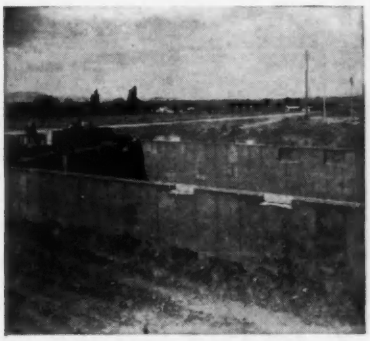
Double 2 x 4 Walers for Alignment. Walers are placed 18" from the top of the 8' panels. There are no walers at the bottom. Waler plates are hung on cross members which helps speed erection. When stripping the forms, buckets are placed close at hand for holding the wedges, waler plates, connecting bolts.



11:00 A.M. Foundation Ready to Pour. Yes, just 10 man-hours to set up 2,000 square feet of forming. And it's an everyday occurrence. Paying local rates ($3.00 an hour) cost of erecting is 1½c a square foot. Stripping in 8 man-hours costs about 1c a square foot. Pouring takes about 6 man-hours.



Stripping and Loading Forms and Fillers. Two men on the outside wall, two men on the inside wall stripping the forms. One man on the flatbed truck loading in a neat, orderly manner. This eliminates stacking, restacking and piling . . . all extra handling operations which cost money. Forms are cleaned before loading on trucks.



24 Man-Hours Later . . . Completed Foundation. Morris J. Smith is an excellent example of a concrete contractor who has put the Symons Forming System to work efficiently and profitably. 9 to 11 house foundations, similar to the one shown above, are poured every week by Mr. Smith and his crew.

In explaining how this has been accomplished, it is best to proceed step by step. On materials: We use the same limestone and sand-gravel for our highway pavements that we use on commercial work. This eliminates the fear by the inspectors that they might receive inferior aggregates on their work. Our aggregate handling in our plants has been engineered to provide for rapid unloading and large stockpiling so that the contractor can be assured of adequate supply. In Nebraska cement is tested at the mills as separate silos are filled, with subsequent shipments being tagged to show that they were shipped from a State approved silo. This method of cement testing is less costly to the State than separate car testing. Our plants are equipped with silos which have separate compartments for State tested cement. The cement is delivered to the weighing hopper by a separate auger. Our plants are equipped to accurately weigh materials to produce concrete within the yield limitations and slump requirements of the specifications. A sufficient number of truck mixer units is used to provide a uniform rate of delivery to the project. The truck mixers can discharge concrete with a maximum slump of 2 inches at considerably more than a cubic yard per minute. Our concrete is delivered to the project by traveling on the shoulders of the roadway, approaching the project from the rear and leaving the site in the direction of the progress of the work. Two different types of spreaders have been used by different contractors. These units operate on different principles, but work equally well.

In general we believe that the following specification requirements pertaining to the equipment used in production and delivery of ready mixed concrete would be fair to the producer:

> *Plant facilities should provide accurate proportioning with a production of at least one cubic yard per minute for a specific paving project.*
>
> *Sufficient delivery equipment should be provided to deliver the concrete to the project at a uniform rate with the delivery equipment being capable of unloading concrete having a slump of a maximum of 2 inches at a rate of at least one cubic yard per minute.*

(continued on page 20)

As in Los Angeles today . . .

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The men who designed and built these outstanding modern structures specified and used POZZOLITH to assure concrete of superior architectural and structural quality at lowest possible cost.

Over the years—in cities throughout the world—where careful attention is given to concrete performance and economics, the use of POZZOLITH is increasing steadily. Over 180 million cubic yards of POZZOLITH concrete have been placed to date . . . a significant proof-of-performance record.

For *your* job . . . with *your* materials—POZZOLITH concrete is best. Neither plain concrete nor concrete with any other admixture can match the results you'll get with today's POZZOLITH.

On current or future concrete projects, the local Master Builders field man will welcome discussing your requirements. Call him in. He's at your service—backed by the Master Builders research and engineering staff—unexcelled in the field of concrete technology. Write us for full information.

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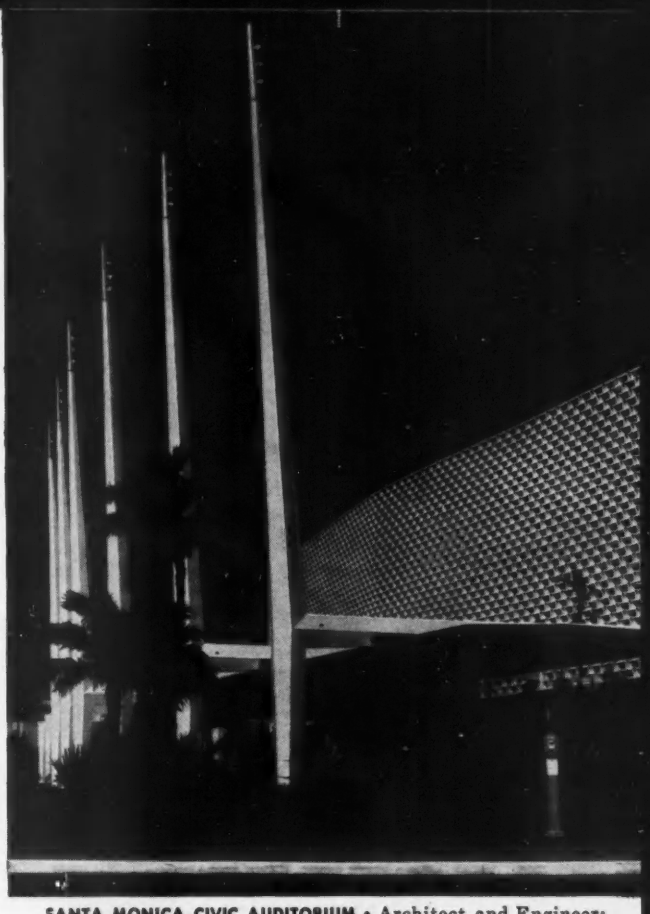

SANTA MONICA CIVIC AUDITORIUM • Architect and Engineer: Welton Becket & Associates • Structural Engineer: Murray Erick Associates • Contractor: C. L. Peck; Millie-Severson, Inc. • POZZOLITH Ready-Mixed Concrete for lightweight concrete panels: Consolidated Rock Products Co. • Concrete Testing and Control: Raymond G. Osborne Laboratories, Inc.

LOS ANGELES COUNTY COURT HOUSE • Architect: J. E. Stanton; Paul R. Williams; Adrian Wilson; Austin, Field & Fry • Engineer: Brandow & Johnston • Contractor: Gust K. Newberg Construction Co. • POZZOLITH Ready-Mixed Concrete: Consolidated Rock Products Co., Inc. • Concrete Testing and Control: Smith-Emery Company.

LOS ANGELES COUNTY ART INSTITUTE • Architect: Austin, Field & Fry • Engineer: Wheeler & Gray • Contractor: Tom E. Norcross • POZZOLITH Ready-Mixed Concrete: Livingston Rock & Gravel Co., Inc. • Concrete Testing and Control: Raymond G. Osborne Laboratories, Inc.

LOS ANGELES MEMORIAL SPORTS ARENA • Architect and Engineer: Welton Becket & Associates • Structural Engineer: Brandow & Johnston • Contractor: L. E. Dixon Co. • POZZOLITH Ready-Mixed Concrete: Consolidated Rock Products Co. • Concrete Testing and Control: Raymond G. Osborne Laboratories, Inc.

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Highway specifications are often inconsistent. For example, certain highway engineers require the concrete to be placed directly against the spreading equipment, not placed a reasonable distance in advance of the spreader; yet if they were to build highway pavements using reinforcing mesh, it is quite obvious that they would have to change their specifications because the finishing machine must travel a considerable distance in leveling the first layer of the slab to accommodate the wire mesh mats.

We believe there is less segregation in the concrete when delivered by truck mixer than when it is rapidly discharged from a paver bucket. Low slump concrete delivered by truck mixer from both sides of the paving project, discharged at a low velocity and partially spread by the moving of the unloading chutes, places the concrete in an excellent position for final spreading and finishing. If it is the belief of certain highway engineers that the clamshell opening of the paver bucket is gradually opened and the concrete dispersed slowly on the subgrade, we would encourage these same individuals to increase the length and frequency of their visits to a paving project. In order for a paving contractor to develop high volume through an on-job paver, it is necessary that he charge the bucket rapidly and also discharge it rapidly.

Recently the writer inspected several paving projects and in one case the contractor was using a drag behind the paver to save the dribblings that were extruded from the discharge end of the mixer, while the bucket was out on the boom discharging. In another case, a laborer was following the paving mixer with an end-dump truck, shoveling the dribblings into the truck. Yet, should one pebble drop from the chute of one of our truck mixers before the concrete is placed between the forms, we are criticized. We are a third party and we must please the inspection group and our customer, the contractor.

Frequently, we hear it stated by highway engineers that more inspectors are required when ready mixed concrete is used. Let's analyze this for a moment. Let's assume that the aggregates and cement are tested and arrive at the ready mixed concrete plant and at the contractor's batching plant with the same inspection demand. We are even at this point. Now the paving contractor should have an inspector at the aggregate proportioning plant and he should have another inspector at the cement proportioning plant. On the project, there should be an inspector riding the paving mixer. This is a total of three. In our case, we have had only one inspector at our plant. The inspection force from the time the concrete is placed would be the same in either case. So it actually requires two more to inspect an on-job mixing operation than when ready mixed concrete is used.

Many times the contractor will indicate that when he mixes his own concrete he realizes a better yield control. Certainly the State Highway Department should feel confident that with the introduction of a third party, the ready mixed concrete producer, the yield control is much more accurate. Also, the State inspector should conscientiously strive to maintain balance in his mix design so that full yield is realized. Our Nebraska specifications have a maximum slump of 3 inches. However, for interstate and primary road construction the concrete mix is designed for a maximum slump

(continued on page 22)

For letter-perfect concrete

To head the class in concrete construction you have to be a letterman today. The letters WRDA and DAREX AEA . . . symbols of concrete quality!

REDUCE WATER with WRDA and gain all the benefits of a low water/cement ratio. You end the problems of watered-down concrete . . . yet mixes flow as smooth as country cream, compressive strengths zoom up as high as 25%.

ADD AIR with DAREX AEA, and a billion little air bubbles spread instantly through the mix, lubricating it for smoother, faster placement. As the concrete hardens, these bubbles guard against frost damage and cracking, even with repeated exposures to freezing and thawing.

You too can be a letterman. Use WRDA and DAREX AEA; a concrete combination that spells out a solid future.

W. R. GRACE & CO.
DEWEY AND ALMY
CHEMICAL DIVISION
Cambridge 40, Massachusetts
San Leandro, Calif., Montreal 32, Canada

of 2 inches. When we are producing concrete for use on super-elevated curves and steep grades, it is delivered having approximately a 1 inch slump.

During one recent panel discussion on ready mixed concrete in pavement construction, it was stated that many of the states require a lower slump than a maximum 2 inches. However, in many instances those specifications requiring a lower slump, such as 1 inch or less, also grant the engineer in charge the authority to increase the slump limit if satisfactory workability cannot be obtained within the specification limits. A low maximum slump requirement merely results in producing concrete at the maximum permitted, and with the unobserved slightest variation in moisture content the concrete produced would violate the maximum slump limits.

Most highway engineers would probably agree that when materials are loaded into batch trucks at a location a considerable distance from the paving mixer, it would require an unusual communication system to keep the mixer operator informed of the variations in the moisture content so that the amount of water added at the paving mixer could be effectively adjusted. At a ready mixed plant, the moisture content of the aggregates and the mix adjustments are all under the supervision of one inspector. To close the circuit between the project and our plant, we station our service representative, who is equipped with a mobile telephone, at the project.

The second question asked by many ready mix producers is "How are you able to sell the contractor?"

When we are notified that bids are being invited from the contractors on a paving project which we believe to be within economical haul distance of our plants, we meet with each contractor and review the plans. During this discussion, we explain the production that we will guarantee on the straight-of-way portion of the pavement. The criterion of a production equal to 50 percent more than a contractor can achieve with one 34E dual drum paver has been very effective in closing our sales. Where there are interchanges consisting of loops and ramps, intersections and varying widths of pavements, we show that we can deliver concrete to more than one location simultaneously and supply concrete at a rate to meet the maximum demand, which results in our serving the project better than the contractor

(continued on page 24)

can serve it with his own equipment. On the structures, it is usually far more advantageous to use ready mixed concrete than for a contractor to attempt to set up a plant for producing small volumes. Those contractors who place the project in clear focus, and who view their costs accordingly, realize that when a ready mixed concrete company can provide for them production meeting the specifications and their delivery schedule, they are relieved of much expense and responsibility in coordinating the shipment of materials, stockpiling, and arranging their labor and equipment forces to provide the same services.

Unfortunately, some prejudiced contractors forget the many headaches involved in providing this coordination. Oftentimes they will comment that they have the equipment and that they might as well use it. Sometimes it is difficult to persuade the contractor to place a realistic value on the costs of moving a plant in and out for a project, to evaluate the costs of materials which they lose when they are unable to reclaim the bottom portions of their stockpiles, the cost of providing water, demurrage on rail shipments, power, operating supplies, and the cost of more working capital.

It was mentioned earlier than when we deliver concrete on pavements we approach the project from the rear and travel on the shoulders of the roadway. We unload and leave the project by traveling in the direction of the progress of the work. When a contractor operates his paving mixer on the shoulder, he experiences a great deal of difficulty through the fill sections of the roadway because the batch trucks have to turn around and back to the mixer. This is always a headache for the paving superintendent to handle the batch truck traffic. Because of this confusion, the contractor's exposure to accidents is greatly increased. Delivering ready mixed concrete to a project is a much smoother and more efficient operation in every respect.

Those paving projects which have structures, interchanges and intersections are much easier to sell because the overall price for the entire project is very attractive when the contractor compares it with his costs. It is necessary that you equate or balance the various quantities to develop a fair selling price.

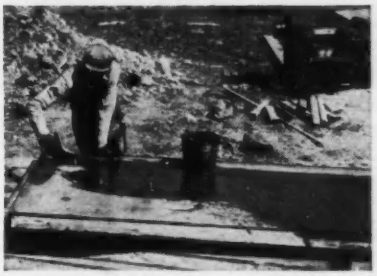
When these details have been completely discussed with the contractor,

(continued on page 26)

Concrete basements stay dry when builders follow these rules

It's easier to build a dry basement than to repair a leaky one afterward. Here is how to build leak-proof, cast-in-place walls to make a dry concrete basement.

Place footings on firm soil below the frost line, following building code requirements. If no code applies, make the footing as thick as the wall and twice as wide.



Use sound forms, well braced, for walls that are true to line and grade. If re-using forms, be sure panels are carefully cleaned, then oiled, soaped or lacquered on inside surfaces.

Use a quality concrete mix, placed in 12-inch, even layers. Spade or vibrate to settle concrete. To prevent segregation in ready-mix, deliver at enough points to avoid long chuting distances.

Strip forms after concrete hardens. One or two days is usually long enough in summer—four to seven days in cold weather. Pull out or break off tie rods, patch holes with mortar.

What about condensation?

Often builders are blamed for leaky basements when the trouble is condensation. Avoid this by explaining that condensation can be controlled by ventilation, covering cold water pipes or installing a dehumidifying unit.

Paint all exterior walls with class "B" portland cement paint or two coats of hot bituminous material. To smooth interior surfaces, rub with carborundum stone and cement-water mix.

Place drain tile around the outside of the footing, except in dry climates or in extremely well-drained soils. Cover the tile with a 12-inch layer of coarse aggregate.

it is imperative that your materials, equipment and personnel be of such caliber that you will be able to perform in accordance with the schedule that you have promised to maintain. The greatest injustice that a ready mix producer can inflict upon a customer is to mislead the contractor and fail to perform during actual construction. It requires many successful ready mix supplied jobs to erase a contractor's prejudice against ready mixed concrete as a result of just one poorly supplied job.

We found this work profitable because of the effect of increased volume on our fixed costs. Each time we figure a paving project we travel all of the delivery roads, estimate the delivery time for the various segments of the project, and analyze our cost of delivery both from the standpoint of an hourly charge and distance. Our plant costs are equated on an hourly production basis for the separate volume demands required throughout the project.

Careful planning of the execution of the work is essential. Prior to the beginning of the paving operation, all of our key personnel who will be on the job meet with the key personnel of the paving contractor to receive a thorough briefing on the responsibilities of each individual. As the plans are reviewed, every detail is discussed: Our ready mix trucks must have the right-of-way as we travel on the shoulders of the roadway. The form setting crew, the water wagon operator, and the hand finishers must thoroughly understand that our delivery units have top priority and must not be detained. The locations where our drivers will be permitted to flush off their chutes are designated. The laborers supplied by the contractor for handling our mixer chutes are instructed on how the chutes are to be rotated during unloading. The contractors' representatives who sign each delivery ticket are instructed to do so in the minimum time. On the paving project supplied last fall we were unloading six cubic yards of concrete in three minutes with a total time on the project of five minutes.

Following this briefing session with the contractor's representatives, we select our first team of plant men and professional drivers. We impress them with the challenge that we face in serving the project and explain how each of them can help in meeting this goal. We are pleased to say that our men have in every case realized their individual importance in helping our company fulfill its commitment with the contractor.

If the ready mix industry is to meet this challenge, it must continue to work with specifying groups for a realistic specification, and to emphasize with them the many advantages of using ready mixed concrete. The ready mix producer must be willing to make the capital investment for equipment. Equipment must be engineered specifically to serve pavement projects. Personnel must be trained as a team and more careful planning is required than for normal building construction. Producers must make sure before contracting for a job that equipment and personnel are adequate.

All our company's experience to date has contributed to the writer's firm belief that the ready mix industry can and will play a major role in supplying concrete for highway pavements. END

survey analyses 1958 production of ready mixed concrete

The National Ready Mixed Concrete Association has completed its eighth annual survey of the production and value of ready mixed concrete, incorporating information covering 1,792 of the 3,481 companies known to be operating in this field.

The reporting companies produced 81,293,451 cubic yards of concrete valued at $1,114,355,650, or $13.71 per cubic yard. A similar study of 1957 production showed an average value of $13.43 per cubic yard.

California led all the states with a reported production of 10,366,259 cubic yards. Ohio was second with a reported production of 5,105,078 cubic yards.

The survey showed that home building continues to be the largest market for ready mixed concrete, accounting for 33 percent of 1958's reported total production, compared with only 29 percent in a similar study of 1957 output. Commercial construction was the second largest use category, accounting for 18 percent of total production, which was also the comparable proportion in 1957. Other consumption categories in 1958 were as follows: highway construction 11 percent; non-Federal public works 8 percent; Federal public works 5 percent; and farm construction less than 3 percent. Miscellaneous uses accounted for a little over 3 percent, while approximately 6 percent of the reported total output was not accounted for on a use basis.

The survey shows that 77 percent of the total yardage was produced by transit mixing. Central mixing, of course, accounted for the remainder. About 25 percent of the reporting firms indicated they were also engaged in the manufacture of concrete masonry units; 11 percent are also manufacturers of precast concrete; 8 percent are also producers of concrete pipe; and 4 percent reported manufacturing prestressed concrete.

concrete contractors plan 1960 convention for Philadelphia, Pa.

The National Concrete Contractors Association will hold its next annual convention at the Sheraton Hotel, Philadelphia, Pa., January 28 to 30, 1960. Approximately 10,000 square feet of exhibit space will be provided for the display of equipment, tools and products directly related to concrete construction.

Hoist 100 yards per day, *or more* with Lad-E-Vator

Half-ton loads go up as high as 80 feet in a minute on versatile, mobile LAD-E-VATOR Hoist. Users report moving as much as 15 yards of ready mix per hour.

Picture above shows LAD-E-VATOR dumping ready mix into a hopper at the second floor level of the new Shadle Park High School, Spokane, Washington. Contractor is Henry George and Sons, Spokane.

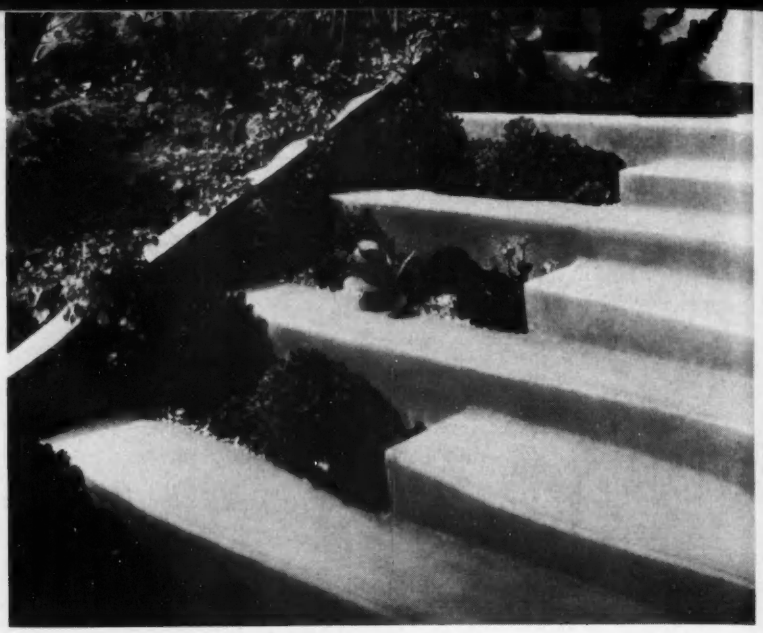
LAD-E-VATOR sets up in minutes . . . only ten minutes with the TRAIL-EREC-TOR towing unit . . . and can easily be moved from place to place on the job. The tower is light, strong and safe, built of tempered aluminum.

LAD-E-VATOR is a money-saver for hoisting almost anything. Take out two bolts, remove the dumping scoop and you have a skip hoist that carries sacked materials, pipe, insulation and many other items. You can dump loads in the work area, or automatically stop LAD-E-VATOR for unloading. A wheelbarrow platform is also available.

If you work above ground level, you need LAD-E-VATOR. Write for literature and price list.

CAMPBELL EQUIPMENT COMPANY

P.O. Box 306, Des Plaines, Ill.



concrete planter stairway

Every other step in the cast-in-place concrete stairway pictured here has been designed to provide space for a decorative planting area. The stairway was cast alongside a concrete retaining wall placed to the grade. The designer points out that the closer steps come to normal walking stride the easier they are to climb. Outdoor steps usually are built with risers lower and treads broader than inside steps.

STOP LEAKAGE with SIKA QUICKSETS

SIKA No. 2

. . . for high pressure leakage thru concrete in deep basements, tunnels, shafts and foundations. Mortar will set in 15-30 seconds - forms plug that bonds tightly. Will not wash away.

SIKA No. 4A

. . . for slow leaks and seepage thru concrete or masonry. Cement mortar sets in 45-60 seconds - bonds tightly to wet leaking masonry. Dilute with water to change speed of set.

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For Fast Setting Pointing Mortar	For Grouting Against Running Water	For Fast Setting Air Placed Mortar

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news

Ohio contractors form association

The Concrete Contractors Association of Ohio came into official existence at a meeting on June 6 at the Carter Hotel, Cleveland. Elected as the Association's first officers were *president,* Fred A. Finomore; *first vice president,* Arthur E. Fabbro; *second vice president,* Ron Mossing; *treasurer,* Charles H. Beck. Rocco J. Russo was appointed legal counsel and Clarence C. Hanna executive secretary.

To date, about 100 concrete contractors from local associations in most of Ohio's major cities have pledged affiliation with the state organization. Associate memberships are open to ready mix dealers and others who function as an integral part of the concrete construction industry in Ohio. The purpose of the Association is to resolve common problems and achieve common objectives in the interests of the members, the industry, and the Ohio community.

construction group elects new officers

Forty members and guests attended the second annual meeting of the Concrete Construction Council of Mahoning Valley at Youngstown, Ohio, in June. Officers elected were: Lewis Herron, *president;* Donald Bostwick, *vice president;* Howard Williams, *secretary;* George V. Shutrump, *treasurer.* First copies of a manual which explains in non-technical language all phases of concrete construction to the customer-owner were distributed.

The Concrete Construction Council was created for the purpose of encouraging the specification, production and proper use of quality concrete construction through promotion, education and coordination of the many segments of the industry.

books

Record Houses of 1959. *Prepared by the Editors of Architectural Record. Published by F. W. Dodge Corporation, 119 West 40th Street, New York 18, N. Y. 226 pp. Illus. $2.95.*

"Easy to care for" characterizes 1959's finest architect-planned houses featured in this book. Clever usage of form, building materials, brilliant color, gardens, and appointments has created designs that feature carefree maintenance and peaceful privacy for owners.

Record Houses of 1959 presents to the house building and buying public a comprehensive view of the best contemporary architect-designed houses—houses which highlight contemporary to the cultural, social, and day-to-day living needs of the average American family.

The honored houses, chosen from the work of architects throughout the country, represent the designs of 20 different architects in 12 states and range in price from $16,000 up. The houses were designed for both merchant builder and individual owner client.

The first section of the book contains five planning guides to the good house, written by authorities in their respective fields, which cover air conditioning and heating, decoration and furnishing, lighting and wiring, mechanical equipment for kitchen, laundry and bathroom, and structural materials and techniques. Each of the award-winning houses is presented individually in the second section. The presentation includes over-all floor plan, photographic coverage of exterior and interior, and a careful analysis of planning and design. A roundup of residential building products for quality houses comprises the third section.

Design and The Production of Houses. *By Burnham Kelly. Published by McGraw-Hill Book Company, Inc., 327 West 41st Street, New York 36, N. Y. 428 pp. Illus. $10.00.*

The entire process by which single new houses are designed and produced is surveyed by leading authorities in this newly published book. Also, courses of action are suggested in which modern methods, materials, and designs can work for the benefit of both the house buyer and the public as a whole.

Dodson's Digest

Countdown

Red "Hurry Up" Bronson is a lanky engineer with a mop of flaming hair and a restless impatience that earned him his other nickname. Today he's one of my best boosters for Calcium Chloride—but with him it had to happen in a dramatic way that we both laughed about later.

He'd been pouring concrete for a new hospital, and I'd finally talked him into using Calcium Chloride in the mix on a short stretch of sidewalk. As usual, he took test cylinders, and after three days we met in the local testing laboratory. The technician wasn't in, but that didn't stop Red Bronson. "I'll check the compressive strength myself," he said, grabbing a cylinder and adjusting it in the machine.

"You'll find the concrete a lot stronger," I said to Red's bobbing figure. "That's because Calcium Chloride accelerates the hydration of the cement, and——"

Suddenly Red's voice began booming off the readings like a countdown in reverse. "1800 p.s.i., 1900 p.s.i., 2000 p.s.i. . . . 3700 p.s.i., 3800 p.s.i."

By now, Red's eyes were bulging slightly out of his head, and I was too astonished to speak. When the reading reached 4500 p.s.i., he exploded. "This is fantastic, Dod! Twenty-eight-day strength in just seventy-two hours! I've got to call the ready-mix plant right now and tell 'em to start adding Calcium Chloride!"

Before I could stop him, he slammed out of the room toward a phone—brushing by the technician, who entered with a small man carrying a tool box. "It's this compressive-strength tester," the technician was saying. "The gauge is way off, and I'd like to get it fixed before some impulsive guy comes in and tries to make a test while I'm gone."

—L. D. Dodson

P.S.—Our free booklet, "How To Make Better Concrete Products and Ready Mix," builds a strong case for adding Wyandotte Calcium Chloride. Send for a copy soon. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.*

Noted experts on architectural design, materials production, site planning, construction, and other aspects of housing discuss in this operational survey the problems and potentials of the field. They explore the complexity and traditional localism of the industry, review the forces that make major changes inevitable, and suggest ways in which rapid advances can be achieved in the future.

Included is a discussion of the mobile home industry, a balanced treatment of labor, constructive criticism of controls, analyses of relationships between design and production, and descriptions of advances in housing. Extensive details and data are supplied throughout, and a number of photographs underline design relationships.

Those directly concerned with housing will gain from this analysis an understanding of how their activities are related to the whole industry. In addition, government officials, industrialists, and others are given a balanced view of the problem of innovation, and a sense of the directions to take for future progress.

Performance of Granular Subbases Under Concrete. *Bulletin 202. Published by Highway Research Board of the National Academy of Sciences, National Research Council, 2101 Constitution, Washington, D. C. 80 pp. Illus. $1.60.*

The three papers in this bulletin were presented at the 37th Annual Meeting of the Highway Research Board.

"Concrete Pavement Subbase Study in Ohio," by L. D. Childs and F. E. Behn, reports the observed condition of an experimental highway constructed in 1952. Several conclusions and indications are given.

"Performance of Subbases for Concrete Pavements Under Repetitive Loading," by B. E. Colley and W. J. Nowlen, reports laboratory data on the performance of subbases under 500,000 repetitions of load. The type and gradation of subbase materials and the placement condition relative to density and moisture content were evaluated.

"Effect of Base Course Gradation on Results of Laboratory Pumping Tests," by W. P. Chamberlin and E. J. Yoder, reports results of a laboratory study to investigate the performance of a variety of base course samples with different gradations.

books

Building Construction Estimating. *By George H. Cooper. Published by McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. 398 pp. Illus. $7.50.*

This extensively revised second edition of Building Construction Estimating, which has won recognition as the standard book in the field, covers in detail all the work of the estimator. Covering all phases of contracting, it is an informative, easy-to-follow book, invaluable not only for the estimator but also for the architect, builder, contractor, building inspector, insurance appraiser, and real estate broker.

New material includes a section on building plans, with a full set of ½-inch scale plans for a house, enlarged coverage of contracts, and a chapter on hardware. The mechanical trades section now offers separate chapters on plumbing, heating, and air conditioning. A chapter entitled "Are You an Estimator?" includes an examination which enables the prospective estimator to place a definite and practical value on his achievements. The first chapters of the book deal with the general duties and relationships of the estimator, and other chapters are devoted to various stages of construction. Appendices include specimen estimate sheets, a glossary of hundreds of construction terms, and essential reference data.

Rapid Tests for Aggregate and Concrete. *Bulletin 201. Published by Highway Research Board of the National Academy of Sciences, National Research Council, 2101 Constitution, Washington, D. C. 24 pp. Illus. $0.50.*

This 23-page bulletin contains two papers as presented at the 37th Annual Meeting of the Highway Research Board.

"Use of Swiss Hammer for Estimating Compressive Strength of Hardened Concrete," by William E. Grieb, describes a simple, quick, nondestructive test method for estimating compressive strength of hardened concrete in place. It can be used in the field as well as in the laboratory.

"Rapid Freezing and Thawing Test for Aggregate," by R. H. Brink, describes a method using a water-alcohol solution as the freezing medium in place of the common sulfate soundness test.

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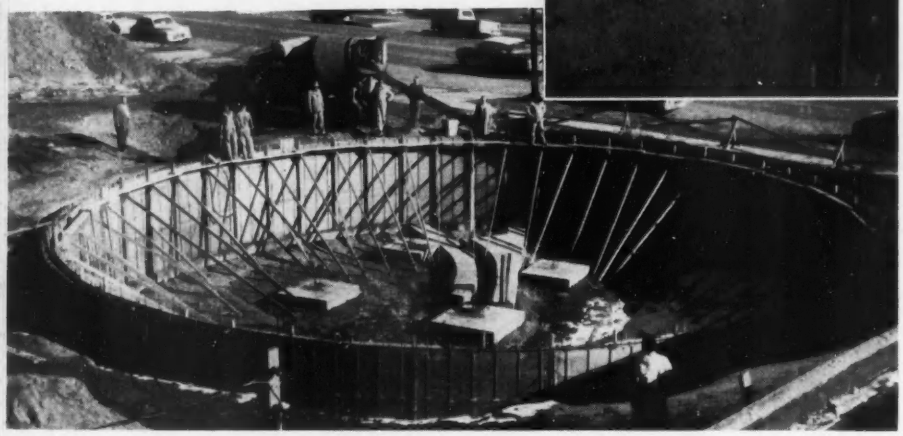
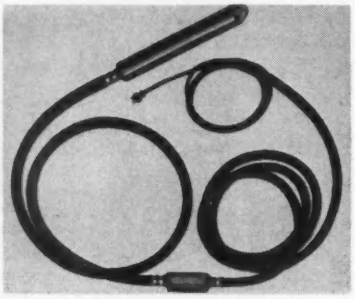
☐ **form ties for circular walls**

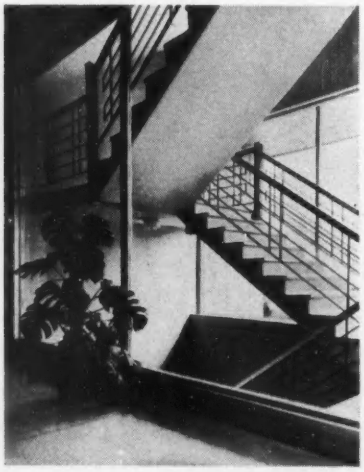
Photos demonstrate unique application of form ties in erecting wall forms for Circular Restaurant, Englewood, Colorado. Inset shows first section of outside panels in place. Next panel is placed on top of the one shown. Note temporary wooden block used to hold panels apart until all rods are in place. Gates & Sons.





☐ **vibrator**

Motor-in-head design permits one man operation on every pour. Waterproof off-on switch can be completely immersed in concrete. Vibrator will not overheat if accidentally operated out of concrete. Designed for use in low slump concrete or wherever heavy duty vibration is required. White Mfg. Co.



☐ **prefab metal stair forms**

One piece units for reinforced concrete stairs are complete with metal riser fronts, reinforcing and temperature rods, plate, channel or exposed stringers. Advantages claimed: lower initial and maintenance costs, accurate dimensions, properly spaced welded reinforcing, flexibility in design of riser, tread, stringer and railings, minimum forming and finishing, greater speed of erection. Stairbuilders, Div. American Stair Corp.

☐ **inflatable void forms**

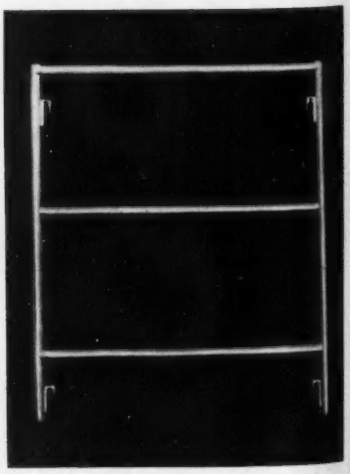
Reusable inflatable rubber void forms, diameters ¾ to 120 inches, are used for casting monolithic pressure pipe and sewers, drains, cored roof and floor slabs, canopy and lift slabs, bridge decks, columns and piers. Catalog 500 provides installation pictures, work sheet and field instructions. Elgood Concrete Forms Corp.

☐ **curing agent**

Designed by Loubet & Glynn, architects, new headquarters for U. S. Geological Survey in California employs four lift-slab roof panels and four second floor panels weighing 700 tons each. According to the contracting firm, Louis C. Dunn Construction Co., the use of Thompson's Water Seal which was used as a curing agent and bond breaker on each of the panels eliminated all trouble in parting and gave an excellent finish. E. A. Thompson Company.

☐ **heavy duty shoring frame**

Photo below shows the heavier capacity frame that has been added to a line of concrete shoring equipment. Manufacturer states these low-cost frames, used with section shoring components, are ideal for shoring heavy concrete bridge slabs, bridge pier caps, and for supporting excessive loads in other types of construction. Will support heavy leg loads and are quickly erected and dismantled. The Patent Scaffolding Co.



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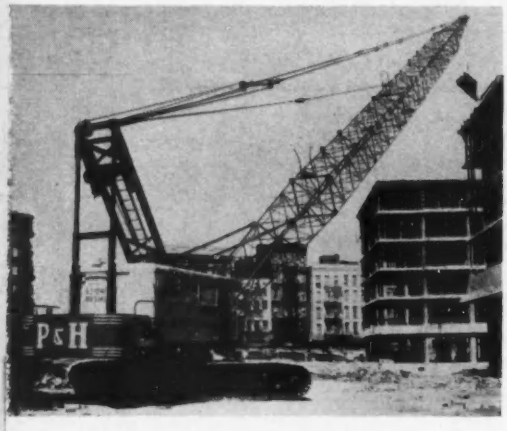
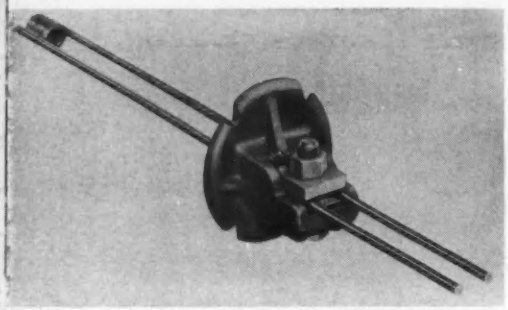


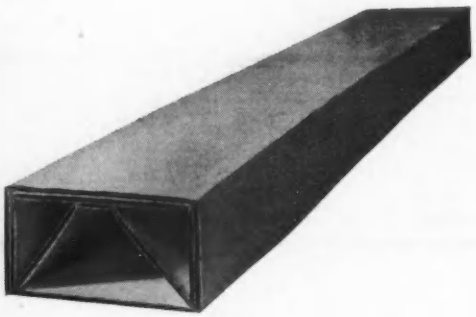
☐ **crawler crane**

A 110-ton P & H 1015 crawler erecting crane with 200 feet of boom pours concrete for fifth floor of building in New York City. On high floors, crane will be fitted with 300-foot boom. Use of the crane enables contractor to pour a floor a day. Each floor requires 700 cubic yards of concrete. Harnischfeger Corp.



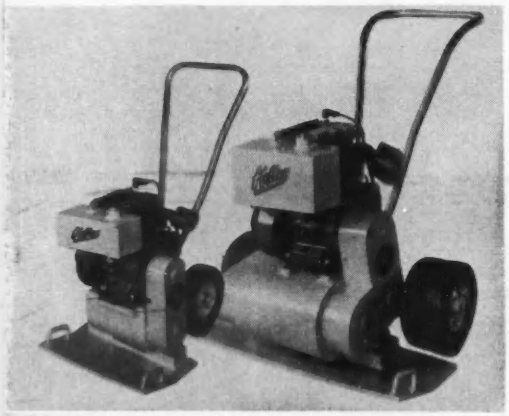
☐ **open end tie clamp**

Provides a fast and simplified method of forming and tying warped and other unusual walls. Coil end of tie, kept back from exposed concrete face, is held in conventional way with coil bolt and washer. Open end is slipped through tie clamp and locked into position at any place on rod. Unit is re-usable. Superior Concrete Accessories.



☐ **forming product**

Jay voids made of asphalt-impregnated fiber board offer cheap insurance against slabs cracking and settling when used in place of sand, gravel or other fill in beam-and-slab construction on grade. Voids deteriorate after concrete dries, leaving positive and calculable space for expansion or contraction. Lawrence Paper Co.



☐ **power tamper**

Portable, gasoline-engine-driven tampers are used for vibratory compaction of granular soils and bituminous surfacing mixtures. In one minute units make 2,400 continuous tamping cycles and propel themselves forward up to 60 feet with compacting force of 12-ton roller. Available with 18-inch or 30-inch shoe. Kelley Machine Div.

☐ **form coating**

One gallon of Poly-Kote-F. G. 54 to 54 gallons of fuel oil provides an easily applied fast drying form coating which completely waterproofs forms. There is no transference of oil to concrete when forms are stripped. May be used on metal or plastic forms also, no matter what coating has been used previously. Brad Chemical Co.

☐ **hot weather concreting**

Tips for best results are presented in illustrated step-by-step form. How to avoid early stiffening, strength trouble, shrinkage cracks, weak surfaces, and cracking in hot weather are explained. Alpha Portland Cement Co.

☐ **subsoil profiles**

Bulletin 1-60.2 tells how a simple, portable instrument is used to learn actual subsoil conditions on construction sites without extensive, costly test borings. Associated Research.

☐ **repair material**

Designed for use in patching of spalled concrete and as protective topping for concrete, PR-940 is an aggregate-filled two-part modified epoxy compound which cures at room temperature, and can be easily troweled onto concrete to form a topping which is said to resist abrasion, weather, nonoxidizing acids, strong bases, alkali salt solutions, petroleum products, and water. Products Research Co.

☐ **form boards**

Supplementary data sheet contains information, including specifications, on Fiberglas form boards for use with lightweight aggregate concrete roof deck construction. Owens-Corning Fiberglas Corp.

Concrete is good...

Reinforced concrete is better

The CF&I Image—symbol of many modern steel products for the construction industry — provides CF&I-Clinton Welded Wire Fabric for crack-resistant concrete work. A steel skeleton adds tensile strength to the concrete, allowing it to cushion the shock imposed by heavy loads. As it absorbs the stress, the steel fabric distributes it evenly in all directions. Thus, the impact is never concentrated in one area.

Steel fabric reduces the chances of cracking during setting. As it holds the concrete tightly together, it helps eliminate heaving due to extreme temperature changes. Should a tiny surface fissure develop, the steel fabric acts like a vise, preventing dirt or moisture from expanding the crack.

For complete information about economical, easy-to-install CF&I-Clinton Welded Wire Fabric, contact nearest CF&I office.

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Moisten the inside of the metal slump cone and hold it firmly by standing on the foot pieces. Fill the cone ⅓ full, using a representative sample of concrete taken from the first, middle and last thirds of the batch.

THE SLUMP TEST

Although concrete is probably the most complex of all the materials of construction, there are fortunately some very simple tests for predetermining some of the properties of this essential material. Consistency, for example, can be determined both easily and quickly by means of the slump test, and everyone charged with responsibility for the performance of concrete should be familiar with the simple procedures used in carrying out this basic test. The photos and simple captions below describe this type of test completely.

Rod this and each of two subsequent layers exactly 25 times with a bullet pointed iron or steel rod, distributing the rodding effort as evenly as possible over the surface. Rod must penetrate into, but not through, the layer placed just previously.

Scrape off excess concrete from the top of the cone by means of a short strike-off board, and also be sure to clean away concrete around the bottom of the cone. Then lift the cone slowly, handling gently to avoid jarring concrete as it slumps.

Place the slump cone beside the concrete and use the tamping rod and ruler to measure to the nearest ¼ inch the distance from the top of the metal form to the top of the concrete. This measured distance in inches is the slump of the concrete.

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